OPTICAL POLARITY MODULES AND SYSTEMS

Field of the Invention

[001] The present invention relates to optical fiber interconnection modules, for example, to interconnection modules for use in a local area network (LAN).

Background of the Invention

[002] Conventional fiber optic cables comprise optical fibers that conduct light which is used to transmit voice, video, and data information. An optical ribbon includes a group of optical fibers that are coated with a ribbon common layer, which common layer may be of the ultraviolet (UV) light curable type. Typically, such a ribbon common layer is extruded about a group of individually colored optical fibers that have been arranged in a planar array, and is then irradiated with a UV light source that cures the ribbon common layer. The cured ribbon common layer protects the optical fibers and generally aligns the respective positions of optical fibers in the planar array. Optical fiber ribbons can be connected to multi-fiber connectors, for example, MTP connectors. MTP connectors can be used in LAN applications, for example, data centers and parallel optics interconnects between servers.

[003] The present invention addresses the need for a fiber optic interconnection solution for MTP connectors in the LAN environment. Conventional networking solutions, which utilize a 12-fiber MTP connector assembly, for example, are configured

in a point to point system. Fiber polarity, i.e., based on a given fiber's transmit to receive function in the system, is addressed by flipping fibers in one end of the assembly just before entering the MTP connector in an epoxy plug, or by providing "A" and "B" type break-out modules where the fiber is flipped in the "B" module and straight in the "A" module.

[004] System problems can occur when the MTP assembly is used in an interconnect construction. Fiber polarity is taken back out of the system when MTP assemblies are interconnected. FIG. 1 illustrates a conventional module "**A**" having six fiber pairs matched as follows: 1-2; 3-4; 5-6; 7-8; 9-10; and 11-12. All of the fiber pairs are defined by fibers that are immediately adjacent to at least one other in the optical fiber ribbon. The immediate fiber pairs are routed to multi-fiber or single-fiber connectors **13** within module **A**; 1 is immediately adjacent to 2, 3 next to 4, and so on. Module **A** is used in a system utilizing an "A" and "B" type module approach where the fibers in the "B" module are flipped with respect to module A to address, or correct for, fiber polarity. Conventionally, MTP connectors are mated key up to key down.

[005] In an effort to reduce implementation confusion, complexity and stocking issues with the "A" and "B" module method, or fiber flipping before entering the connector, the idea of wiring a module in a fiber sequence according to the present invention has been devised. Wiring a module in accordance with the present invention eliminates the need for an "A" and "B" module approach where the module according to the present invention is used universally in the system.

Summary of the Invention

[006] An optical interconnection module having: an enclosure defining walls and a cavity within the walls for receiving and supporting optical fibers and connectors; an optical interconnection section formed in a wall of the module, the optical interconnection section having a multi-fiber connector with multiple optical paths formed therein, the optical paths being arranged in a generally planar array with the paths being immediately adjacent to at least one other optical path for optical alignment with optical fibers in an optical fiber ribbon; an optical connector station formed in a wall of the module having a plurality of optical fiber connectors; the optical paths and the optical connectors being optically interconnected by optical fibers disposed in the cavity, fiber pairs being formed by the optical fibers, at least one of the fiber pairs being routed to a respective connector station that is in optical communication with the optical paths.

[007] In another aspect, an optical assembly, having: at least two optical interconnection modules; the modules being optically interconnected by optical paths, the optical paths being established through connectors and adapters having respective keys being positioned in the same place on the connectors, and optical fiber ribbons; the connectors and adapters being mated with keys in the same relative position; and polarity of the optical fibers located externally of the modules is not reversed.

Brief Description of the Drawing Figures

[008] FIG. 1 is a schematic view of a conventional module.

[009] FIG. 2 is a module according to the present invention.

[010] FIG. 3 is a schematic view of a first optical assembly according to the present invention.

[011] FIG. 4 is a schematic view of a second optical assembly according to the present invention.

Detailed Description of the Invention

[012] An embodiment of the present invention is an optical networking module for use with an optical fiber ribbon, for example having twelve optical fibers, connected to an MTP or MPO optical connector. FIG. 2 illustrates an exemplary module **60** according to the present invention. Module **60** is optically associated with an optical fiber ribbon **20**, for example, having twelve distinctly colored optical fibers **21-32** disposed in a matrix.

[013] Module **60** includes an enclosure defining walls **61** and a cavity **62** within the walls for receiving and supporting optical fibers and connectors.

[014] Module **60** also includes an optical interconnection section having an optical connector. The preferred connector is an MTP or MPO connector **40.** Connectors **40** are epoxy and polish compatible multi-fiber connectors, for example, part of Corning Cable Systems' LANScape® solution set. The epoxy and

polish connector is a twelve-fiber connector achieving very high density in a small space, it contains multiple optical paths, the optical paths being arranged in a generally planar array. The optical paths being immediately adjacent to at least one other optical path for optical alignment with the optical fibers in an optical fiber ribbon. The MTP connector is designed for multi-mode or single-mode applications, and uses a push/pull design for easy mating and removal. The MTP connector can be the same size as a conventional SC connector but provides twelve times the fiber density, advantageously saving cost and space. The MTP connector includes a key for proper orientation for registration with any required optical adapters. An optical connector adapter **41** (FIGS. 3 and 4) can be disposed between the connector outside the module and a connector inside the module. Other connection schemes can be used, however. Preferably, a ribbon fan-out kit is used to manage the optical fibers from between the connector inside the module and the connector stations.

[015] FIG. 2 illustrates an exemplary fiber wiring scheme for routing of optical fibers from connector **40** to single or multi-fiber connectors located at connector stations **51-56**, defined at a break-out section **50** of module **60**. Each connector station **51-56** preferably includes one or more connectors. In the module, an exemplary routing scheme is the following: fiber number 1 (blue) is paired with fiber number 12 (aqua); fiber number 2 (orange) is paired with fiber number 11 (rose); fiber number 3 (green) is paired with fiber number 10 (violet); through the remaining numbers/colors of fiber with the last pair being fiber number 6 (white) with fiber number 7 (red). With reference to FIG. 2, the fiber pairs are defined as follows: 21-32; 22-31; 23-30; 24-29; 25-28; and 26-

27. At least one but preferably at least 80% of the fiber pairs routed to respective connector stations **51-56** are made by fibers not immediately adjacent in the optical fiber ribbon **20**. In other words, the optical paths of connector **40** and the optical connectors at stations **51-56** are optically interconnected by optical fibers disposed in cavity **62** of the module **60**, the fiber pairs being formed by the optical fibers. At least one of the fiber pairs being in optical communication with respective optical paths in connector **40** and being routed to a respective connector station, the at least two optical paths being selected from optical paths not being immediately adjacent to each other. Preferably, 80% of said fiber pairs optically interconnected with the optical paths are selected from optical paths not being immediately adjacent to each other.

[016] Using the modules of the present inventions, interconnection of assemblies are deployable in a network, for example, a LAN. Multiple spans of assemblies can be interconnected. Fiber flips in the trunk assembly just prior to one end of the MTP connector, for polarity correction, is not necessary resulting in a complexity/cost reduction. Finally, a universal wired harness in a module eliminates the need for two different types of breakout modules in the network. The system consists of one or more MTP or MPO trunk assemblies and one (universal) type of breakout harness either loaded in a module or by itself. For example, two MPO connectors mate via an MPO adapter with the key of each MPO in the same relative position, i.e., keys up or keys down. FIGS. 3 and 4 illustrate exemplary systems **80**, **90** respectively, employing modules **60** according to the present invention. Each system **80**, **90** comprises MTP or MPO connectors **40** with

associated adapters **41**, and optical fiber ribbons **20**. All MPO connectors **40** and dual fiber connectors at stations **50** are mated with keys **41a** in the same position, i.e., all keys **41a** up or all keys **41a** down. In systems **80**, **90**, the polarity is not reversed, fibers one through twelve are not flipped between the modules. In other words, the optical paths are not flipped at the adapters or other position between the modules. For example, the optical path remains with its color, blue stays with blue (1-1), orange with orange (2-2), green with green (3-3), and so on, from one module to another including the connectors **40** externally of the modules **60**.

[017] To implement reverse-ribbon positioning in the cabling system the following steps should be taken.

a) Assign each fiber in a given optical ribbon a sequential number, as described hereinabove.
b) As shown in FIG. 3, install the MPO connectors **40** as follows:
    1) On one end of the cable, install an optical ribbon into the connector **40** with the fibers in consecutive numbering (e.g., 1,2,3,4…12) from left to right with the key **41a** up.
    2) On the other end of the cable, install the ribbon into the connector **40** with the fibers in reverse numbering (12,11,10,9…1) from left to right with the key **41a** up.

[018] Transitioning the ribbon cabling into multiple duplex systems completes reverse-pair positioning. This transition can be implemented with transition modules or transition assemblies (see FIGS. 3-4), having MPO to dual-fiber connectors or duplexed single-fiber connectors. If transition

assemblies are used, the positioning of the fibers inside the connectors is implemented the same as the implementation inside the respective modules.

[019] The present invention has been described with reference to the foregoing embodiments, which embodiments are intended to be illustrative of the present inventive concepts rather than limiting. Persons of ordinary skill in the art will appreciate that variations and modifications of the foregoing embodiments may be made without departing from the scope of the appended claims.